DARK ENERGY
SURVEY

FNAL-ANL PreCam Reductions

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DES Collaboration Meeting
ICG, Portsmouth

PreCam Parallel Session
29 June 2011

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Data Processing

- DES-Brazil Effort
  - The official data processing.
  - Uses a PreCam-specific version of the Quick Reduce Pipeline.
    - Quick Reduce in turn uses the DESDM code.

- FNAL/ANL Effort
  - Uses custom scripts in order to understand the data and obtain some quick results.
  - Provides feedback to the official data processing.
  - Most of the *data processing* by Sahar Allam, Douglas Tucker, Kyler Kuehn, and Hope Head, in consultation with Huan Lin, Steve Kuhlmann, Hal Spinka, Tomasz Biesiadzinski, Michael Schubnell, and others.
  - Most of the *data analysis* is being performed at ANL (Kyler, Steve, and Hal), FNAL (Sahar, Huan, Douglas), and UM (Michael). (See Kyler's talk.)

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"Golden Nights"

- "Golden Nights"
  - A set of 5 nights with robust FITS headers, no known problems, and target observations in SDSS Stripe 82:

Night	# of Target Fields in Stripe 82				
	g	r	i	z	y
R2010-12-15UT	1	0	40	29	11
R2011-01-07UT	12	0	0	3	0
R2011-01-08UT	0	7	0	10	0
R2011-01-12UT	0	0	10	19	14
R2011-01-17UT	0	0	3	0	0

  - Used by both data processing efforts for rapid testing and algorithm development.

FNAL-ANL Processing Methods/Steps (I)

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1. A suite of home-grown python scripts are written using (primarily) pyFITS and (occasionally) pyraf.
2. A Master Bias are created by median-combining all good bias frames from entire November – January PreCam observing block.
3. A set of Master Dome Flats are created by median-combining all good flat frames from entire November – January PreCam observing block.
   - Pro: dome flat lamp problems make it difficult to do night-by-night or even week-by-week Master Dome Flats, esp. in late-December and in January.
   - Con: dust specks on the dewar window moved, esp. between PreCam re-mountings.
4. Row-by-row overscan subtraction is performed (takes care of horizontal banding).
5. Horizontal streaking correction is performed on bias-subtracted, flat-fielded science and standard star images. (Important code provided by Tomasz Biesiadzinski and modified by Sahar Allam.)

FNAL-ANL Processing Methods/Steps (II)

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6. Illumination/shutter correction maps are created by median-combining processed on-sky images (standard star fields, science targets)
   - One map per filter per exposure time.
   - A night's worth of images? A week's? Kyler Kuehn is investigating this.
7. To simplify analysis, the data for both CCDs are combined into a single FITS image (with a gap in the middle).
8. For later reductions, IRAF fixpix is used to clean bad pixels/columns.
9. Astrometry/WCS keyword values are corrected first by matching against 2MASS (astrometric pre-burner) and then by using IRAF ccmap routine.
10. Use of SCAMP is being investigated by Michael Shubnell and a summer student.
11. To optimize S/N of fainter stars, PSF photometry (PSFex? DAOPHOT?) will likely need to be used. Hope Head (summer undergrad intern at FNAL) may be investigating this later this summer.

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Reduced Data Sets

- FNAL ("v1")
  - 14 nights processed (superset of Golden Nights)
  - Image de-trending (including horizontal streaking correction), basic astrometric calibration, sextractor catalogs
  - Nearly all analyses to date have been performed on this data set
- FNALv2
  - 49 nights processed (2010-Dec-1 UT → 2011-Jan-18 UT)
  - Just through image processing (no astrometric corrections or sextractor catalogs) so far. Hope Head will be working on astrometry/cataloging.
  - FNAL ("v1") + IRAF fixpix + horizontal streaking image quality flags in FITS headers
  - Start moving analysis to these reduced data (or to FNALv3?)
- FNALv3
  - Just starting
  - Description: FNALv2 + improved horizontal streaking and image quality flags

FNAL Directory Structure

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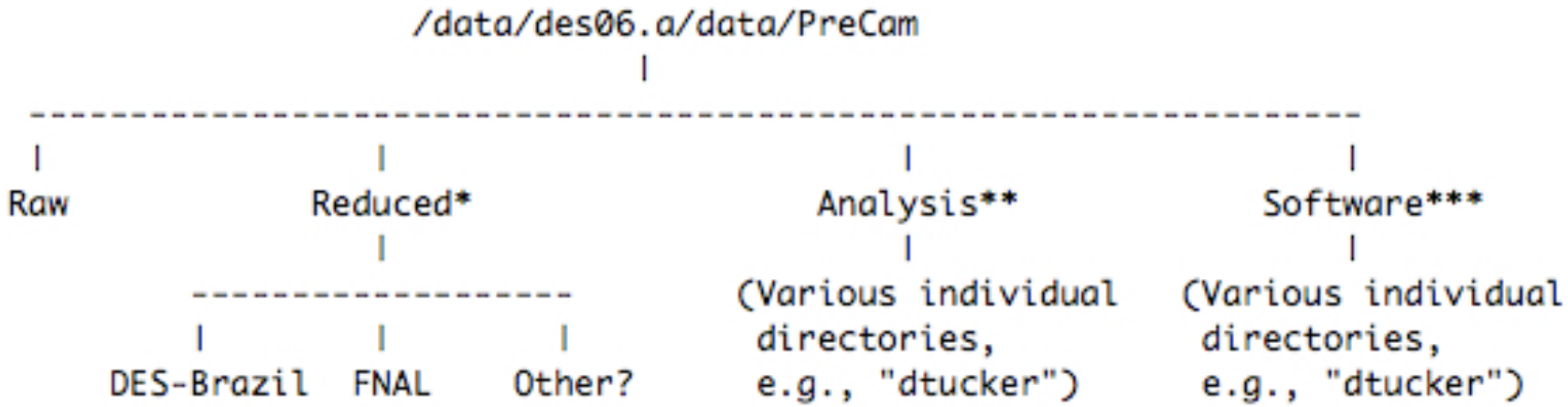
- Experimental Astrophysics Group (EAG) SDSS/DES cluster at Fermilab (e.g., des06.fnal.gov)



* Symbolically linked to /blue-orch/PreCam/Reduced (a disk with lot of free space)
** Symbolically linked to /data/dp59.b/data/PreCam_annex/Analysis (currently)
*** Symbolically linked to /data/dp59.b/data/PreCam_annex/Software (currently)

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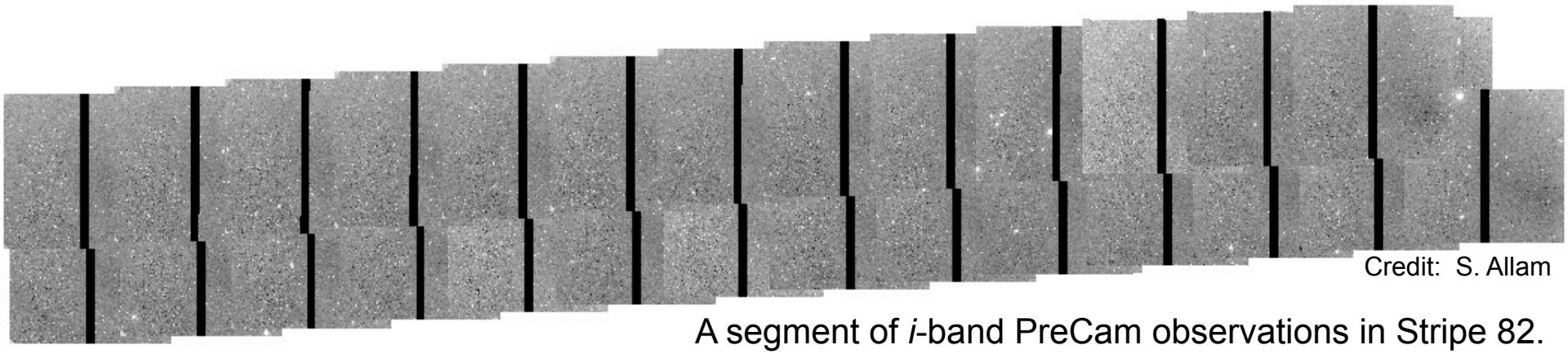
End



Credit: S. Allam

A segment of *i*-band PreCam observations in Stripe 82.
FNAL(v1) reductions.
~20 sq deg.

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Extra Slides

A Processed *i*-band PreCam Image from Jan 13

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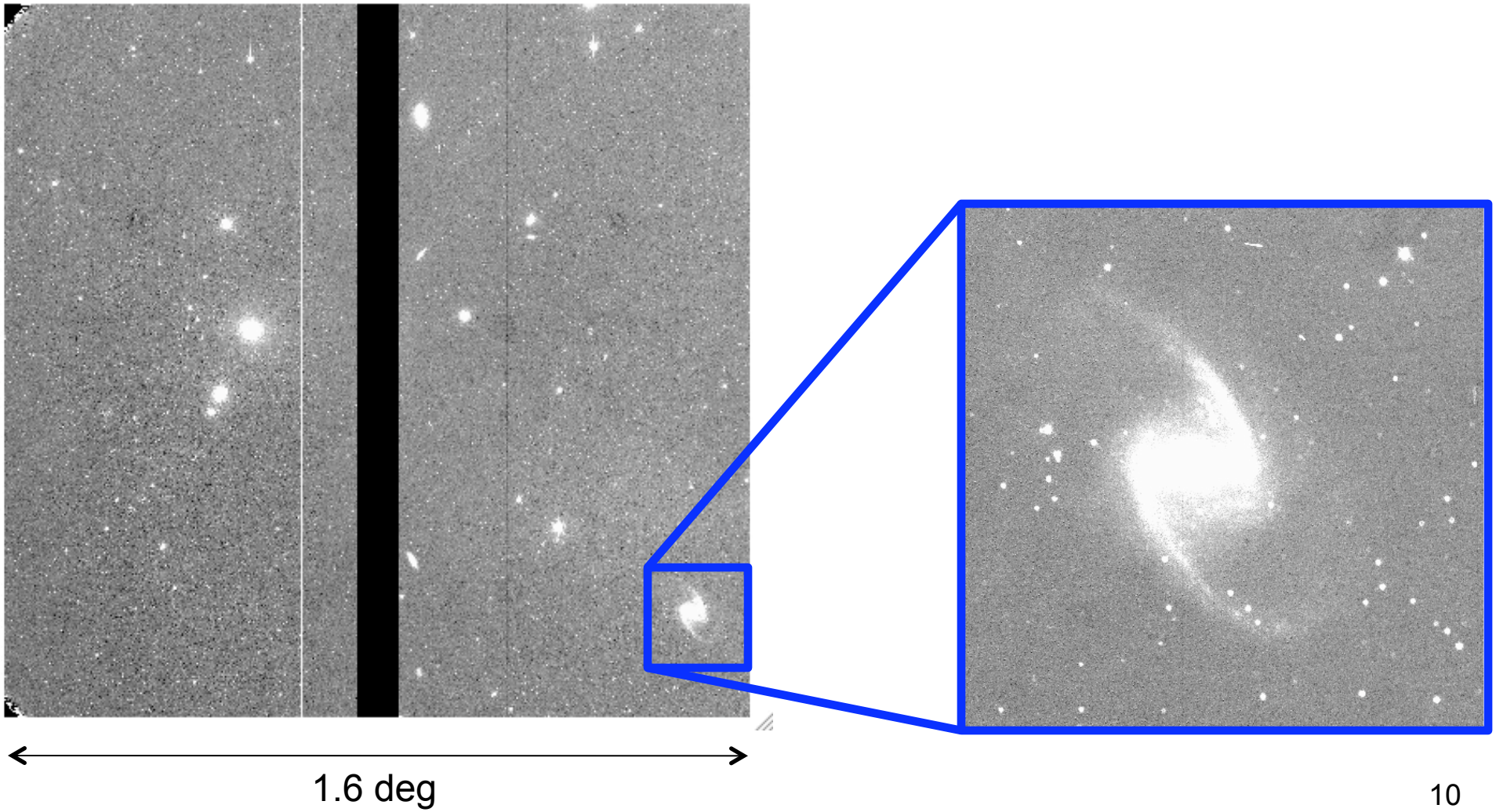

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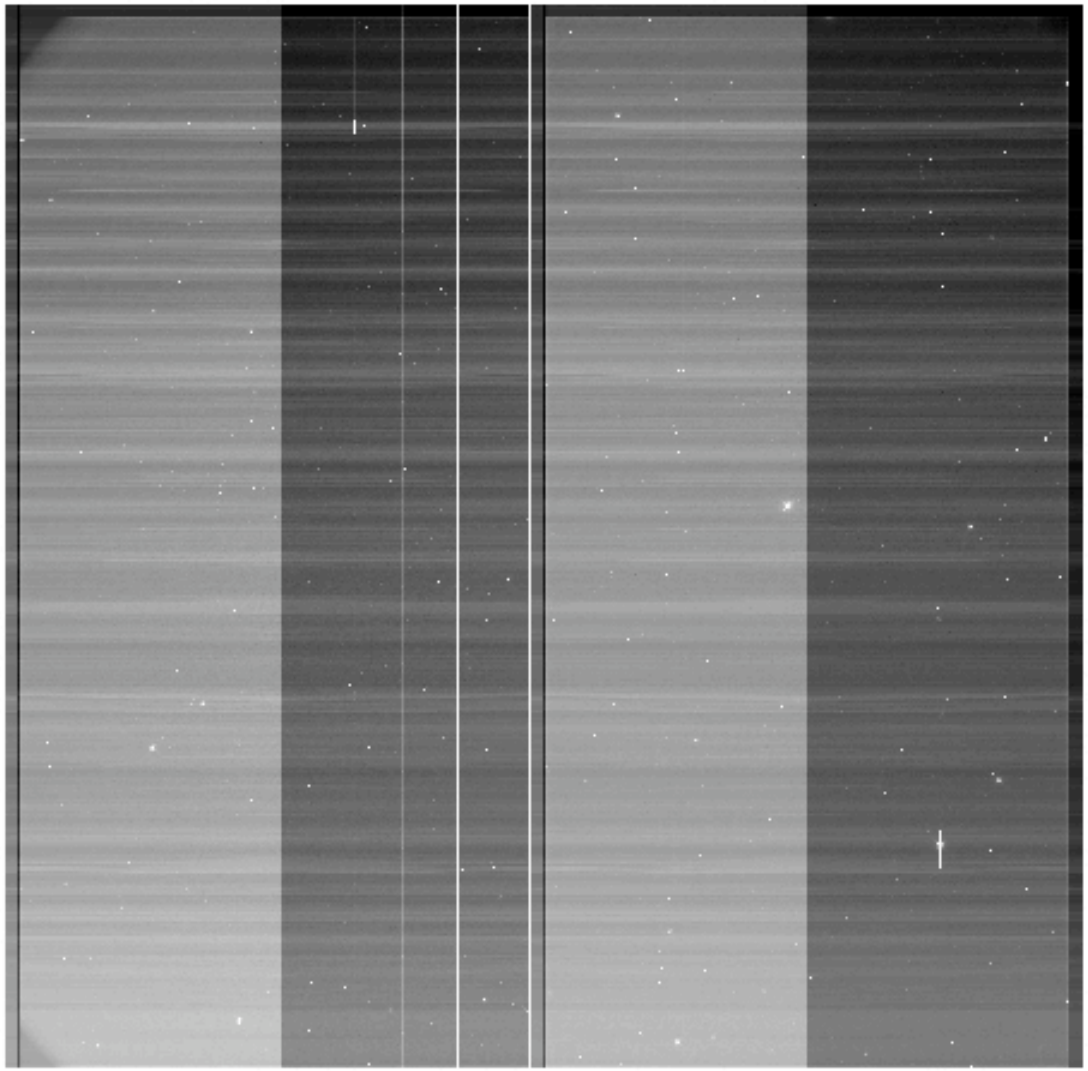
Results: Horizontal Banding & Streaking



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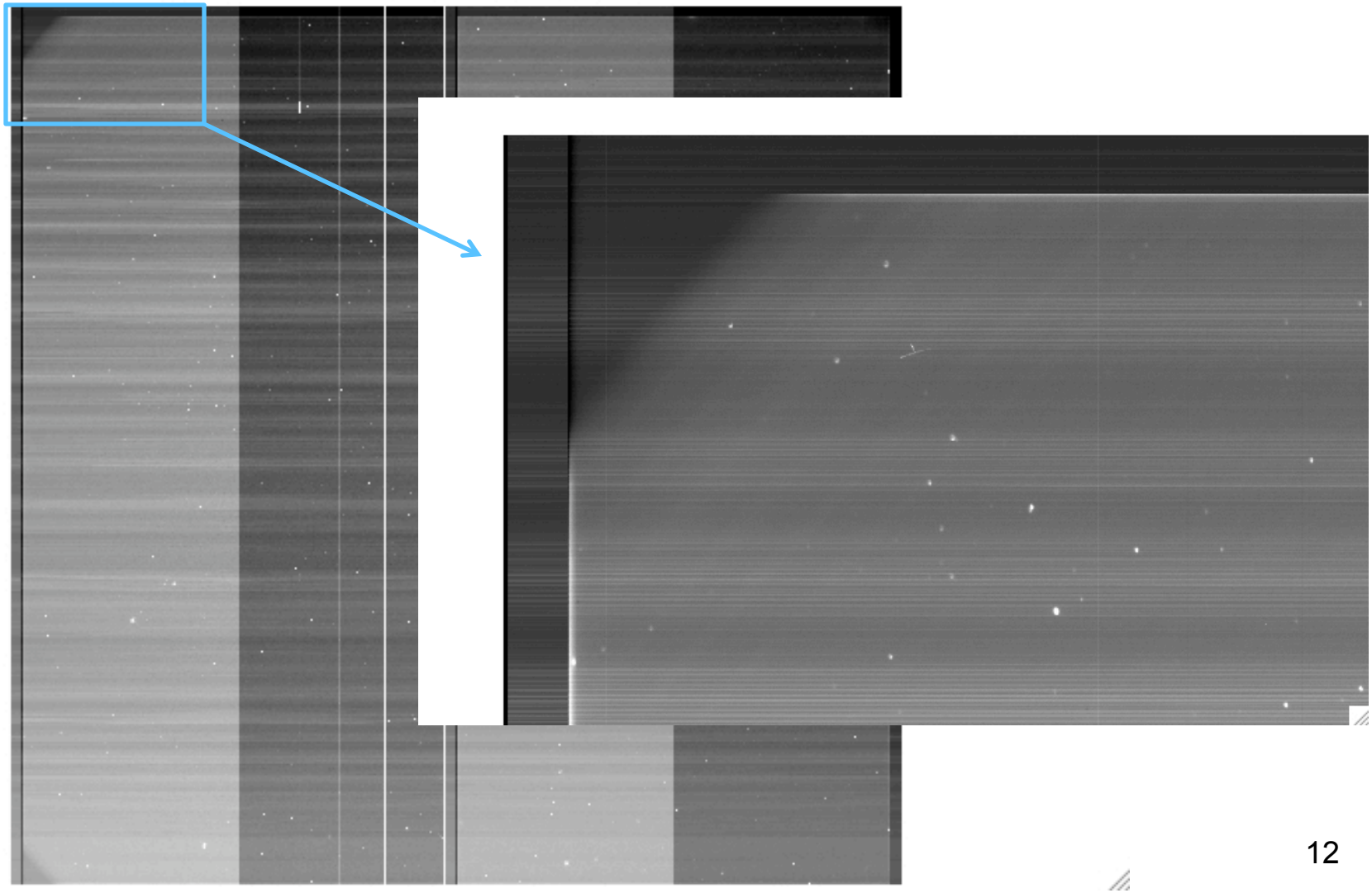
Results: Horizontal Banding & Streaking

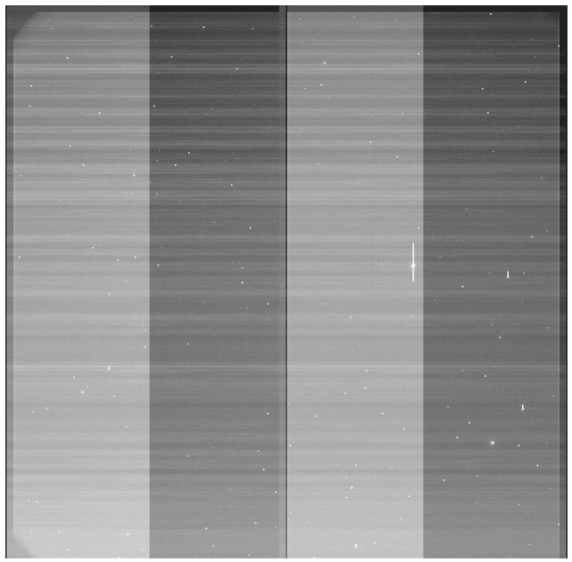


DARK ENERGY SURVEY

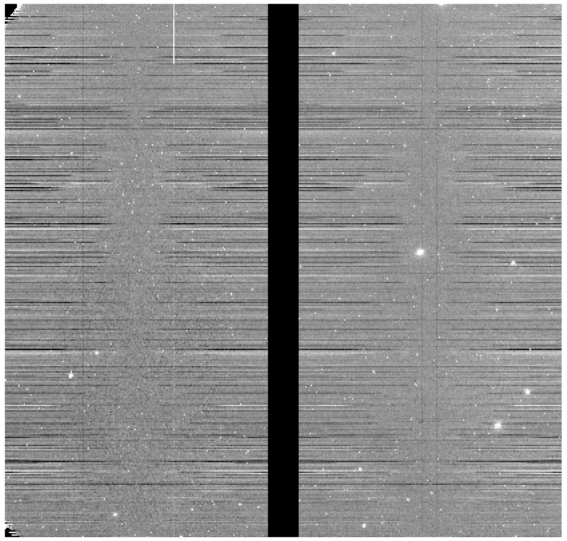
Results: Horizontal Banding & Streaking

A Pretty Bad Case of Banding and Streaking

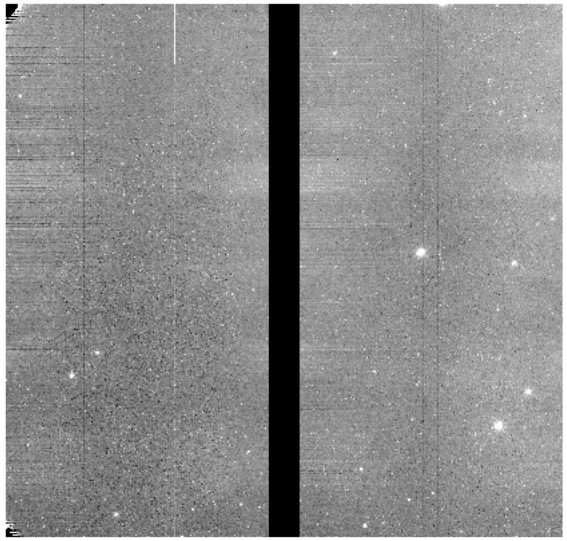
Original Image



After row-by-row overscan subtraction



After horizontal streaking correction



Credit: S. Allam & T. Biesiadzinski

Results:
Horizontal Banding & Streaking

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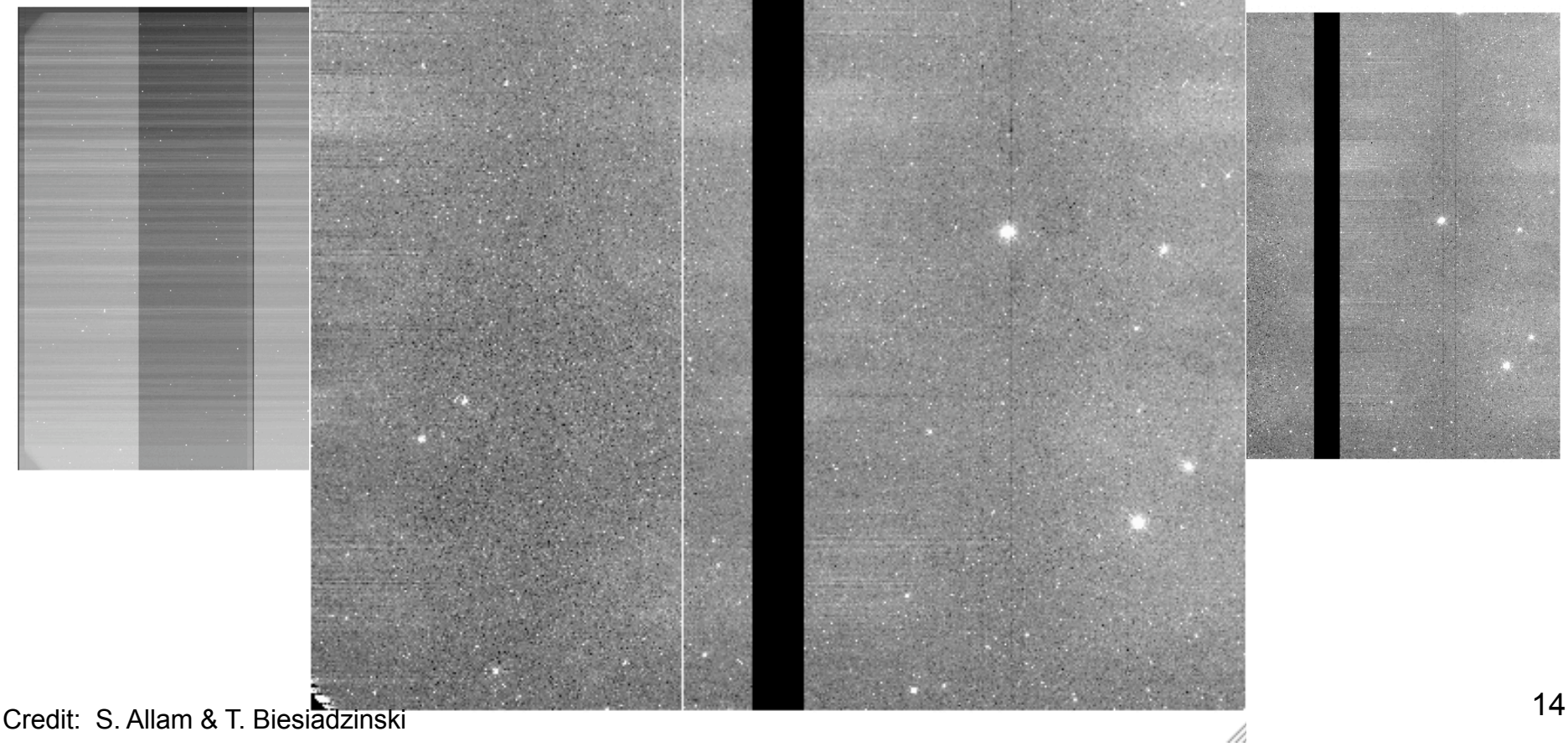
Original Im

er horizontal
king correction



Credit: S. Allam & T. Biesiadzinski

Dome Flat Lamp Output vs. Time

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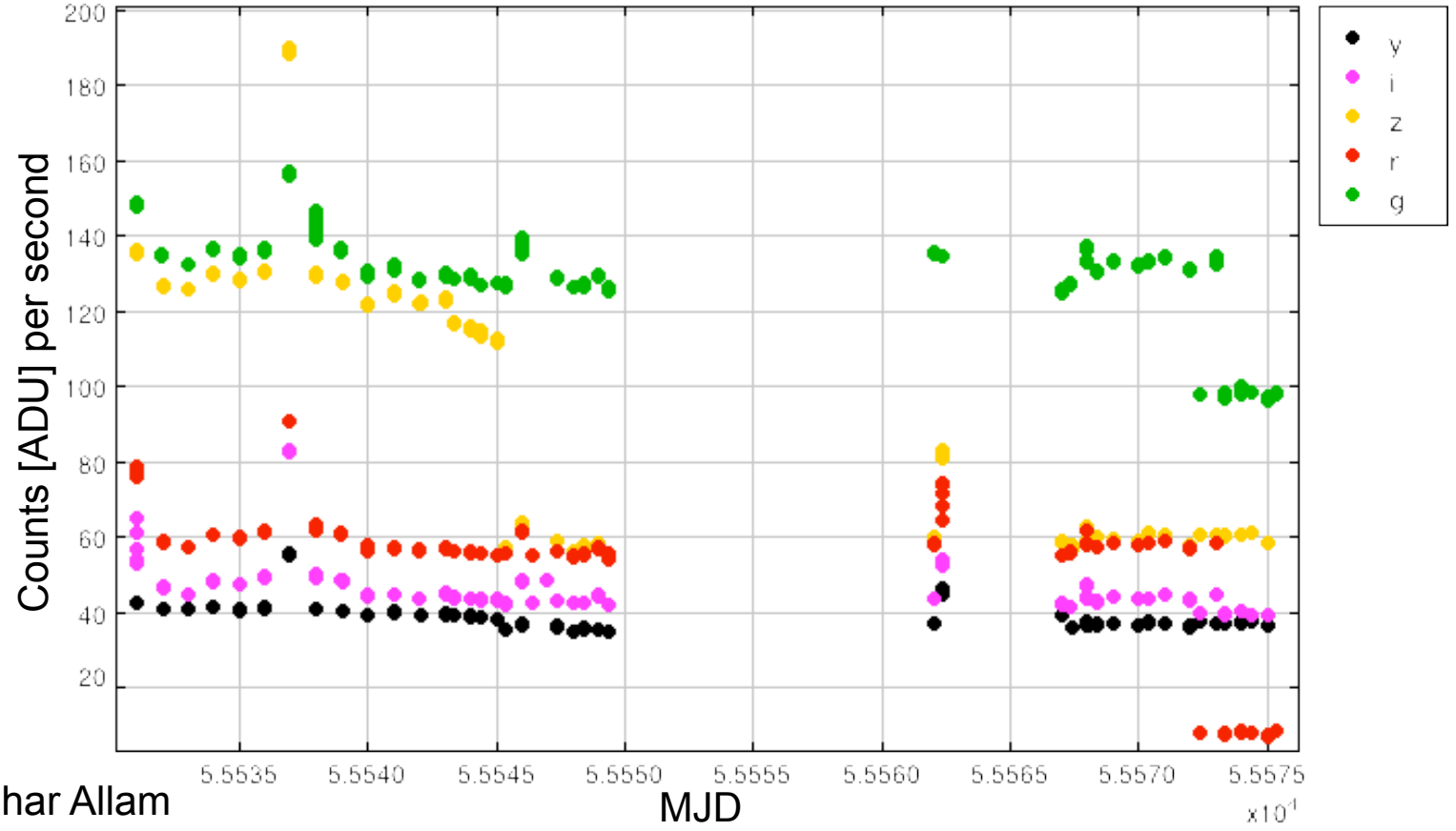

Credit: Sahar Allam

Results: Horizontal Banding & Streaking

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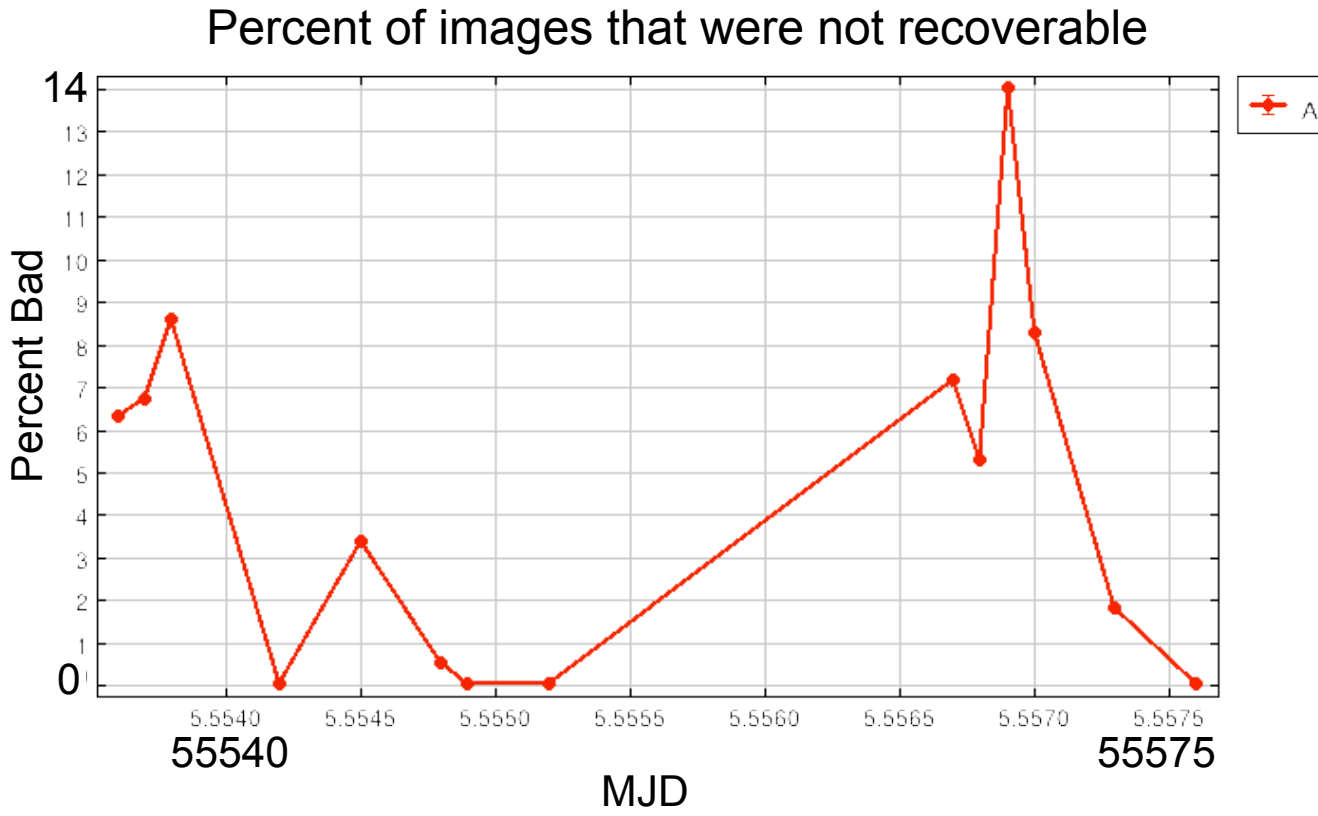
- Horizontal banding & streaking affect ≈40% of the raw PreCam standard star field and science target images.

- After correcting, horizontal banding & streaking affect only about 6% of the processed images.



Credit: S. Allam

Results:
Initial Photometry for a Single Image

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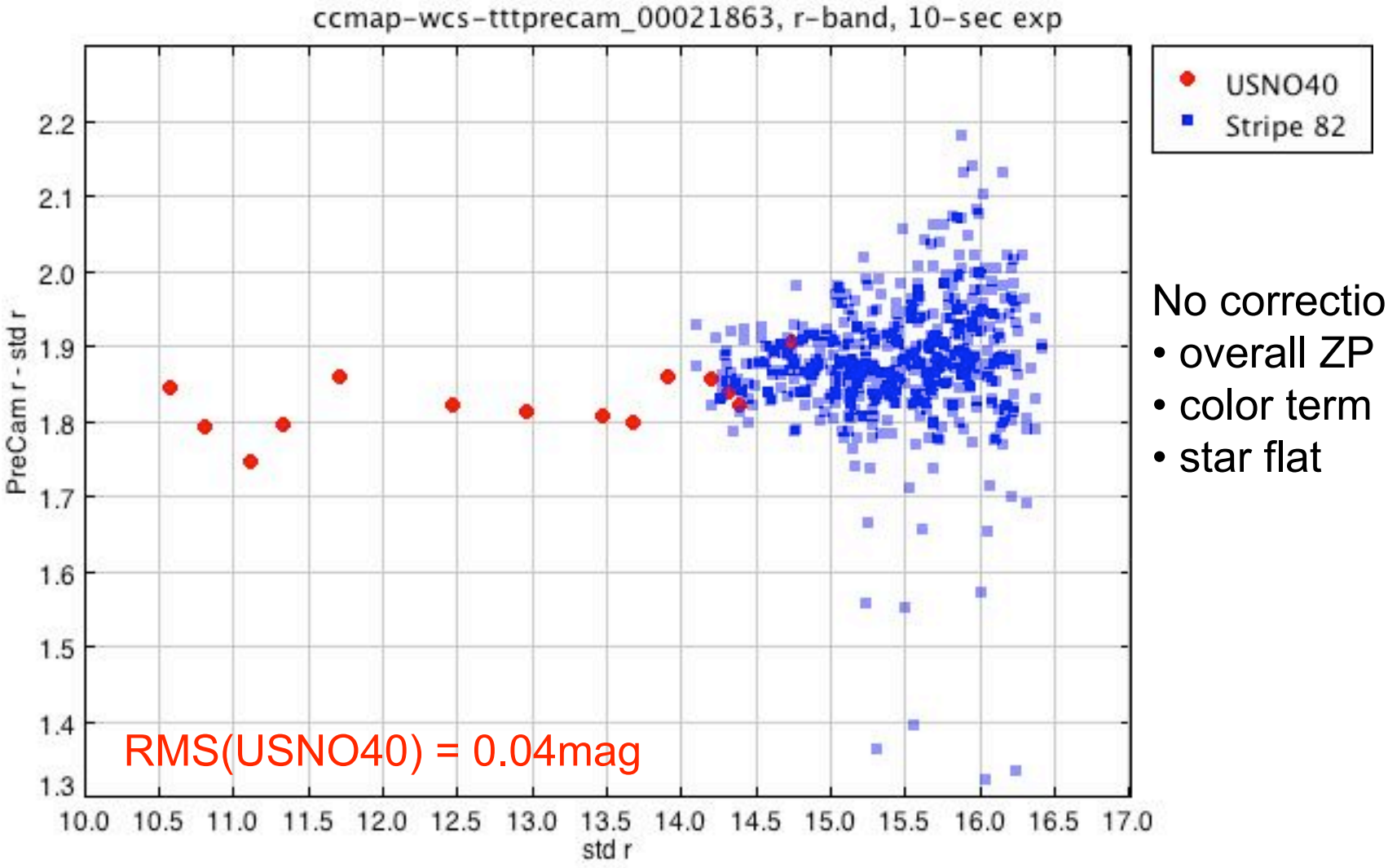

No corrections for:
- overall ZP
- color term
- star flat

Results: Photometry over a Full Night

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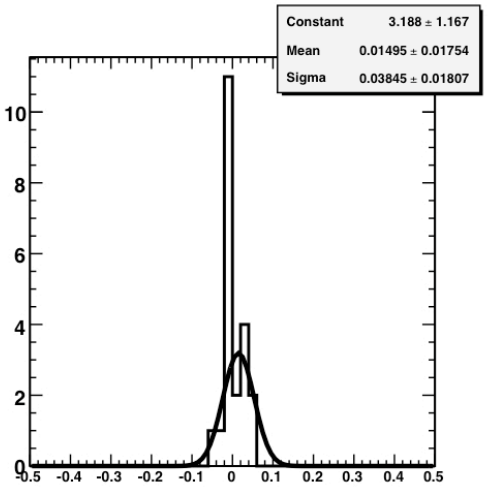
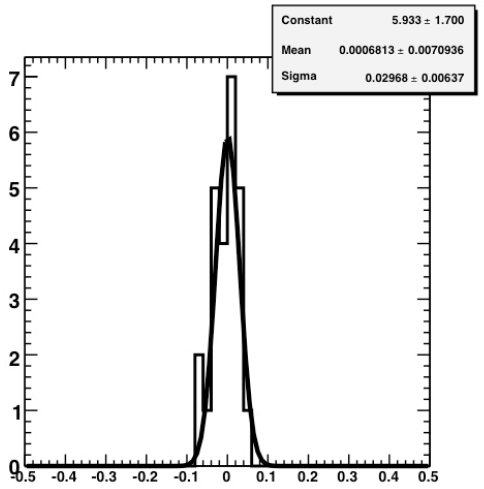
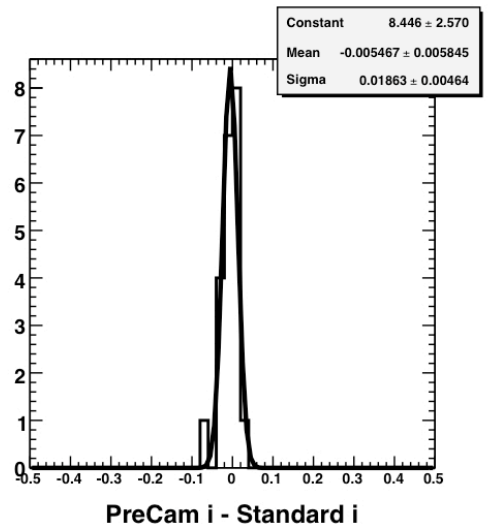
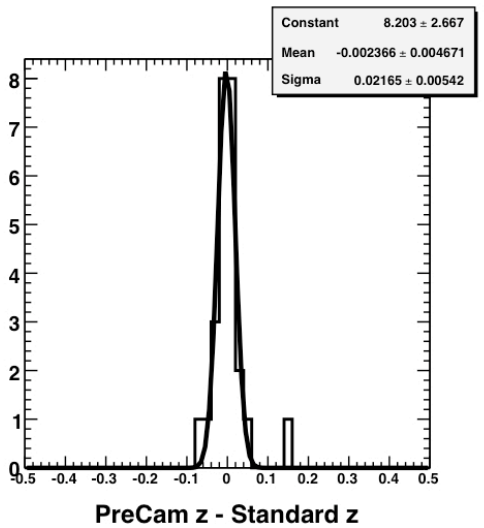
- Night of 13 Jan 2011 UT.
- All data from that night matching the extended list of USNO *u'g'r'i'z'* standards.
- Corrections for overall ZPs and for airmass (using site-average first-order extinction coefficients)
- No correction for color terms.
- RMS = 2-4% (mag < 13.0).









Credit: S. Kuhlmann, H. Spinka